Chapter 6 -Hazard Controls

1.0 Introduction

This document specifically consolidates requirements found in the National Fire Protection Association (NFPA), the American National Standards Institute (ANSI), the Compressed Gas Association (CGA), the Occupational Safety and Health Administration (OSHA), and certain Environmental Protection Agency (EPA) regulations and Department of Energy (DOE) Rules and Orders. This also includes technical standards that are made mandatory by their specific reference within a regulation, rule or DOE Order.

This document does NOT create any new or additional requirements. The listing of consolidated requirements that follows includes "pointers" to the sources of those requirements, permitting the user to track what the requirements are and where each comes from.

2.0 Applicability

This document applies to all locations that use chemicals or chemical products. *[NOTE: Throughout this document, the term "chemicals" is used to indicate chemicals and/or chemical products as described in Section 3, below.]* This document is intended only to address chemical hazard control requirements applicable to chemical user activities.

3.0 Definitions and Acronyms

Approval: Authorization from subject matter experts or the appropriate level of management as defined in local site or facility procedures; or ***Approved:*** acceptable to the authorities having jurisdiction.

Chemical: Any element, compound or mixture of elements and/or compounds. A substance that a) possesses hazardous properties (including, but not limited to flammability, toxicity, corrosivity, reactivity); b) is included on any federal, state, or local agency list of regulated chemicals; or c) is associated with Material Safety Data Sheets (MSDS). For the purpose of this document this definition also applies to ***chemical products*** (see def.)

Chemical Product: A mixture of any combination of two or more chemicals (see def.) that may or may not be the result, in whole or in part, of a chemical reaction, and that itself has hazardous properties. Chemical products include materials such as paints, lubricants, cleaning agents, fuels, etc. and will have MSDSs associated with them.

Class I flammable liquids: Class 1A, Class 1B, and Class 1C flammable liquids.

Class IA flammable liquids: Liquids having a flash point less than 73°F and boiling points below 100°F.

Class IB flammable liquids: Liquids having a flash point less than 73°F and boiling points at or above 100°F.

Class IC flammable liquids: Liquids having a flash point at or above 73°F and below 100°F.

Class II combustible liquids: Liquids having a flash point greater than 100°F but less than or equal to140°F.

Class IIIA combustible liquids: Liquids having a flash point greater than 140°F but less than or

equal to 200°F.

Extremely hazardous substance: a substance listed in appendices A and B of 40CFR355.

Fire area: An area in a building that is separated from the rest of the building by a one- hour fire barrier. All penetrations through this fire barrier must be constructed to maintain the one-hour fire resistance.

Hazard: Potential for radiation, a chemical, or other pollutant to cause human illness or injury.

Hazard Control: The management actions or physical measures taken to eliminate, limit, or mitigate hazards to workers, the public, or the environment, including (1) physical, design, structural, and engineering features; (2) safety programs and procedures; (3) personal protective equipment; and (5) administrative limits or operational restrictions.

Hazardous Material: Any material that poses a threat to human health and/or the environment.

Hazardous Operations: Includes process operations that are subject to regulatory actions because of the presence of one or more specific hazardous materials or types of materials that meet or exceed established thresholds or guidelines. These include operations with chemicals governed by:

- 29 CFR 1910.119, "Process Safety Management of Highly Hazardous Chemicals" or 40 CFR 68.67, "Chemical Accident Prevention Provisions-Process Hazards Analysis;"
- Hazard category 1, 2, or 3 nuclear operations as defined in 10 CFR 830, "Nuclear Safety Management;"
- Operations with Beryllium as defined by 10 CFR 850;
- Facilities with "significant" fire hazards as defined by DOE O 420.1A;
- Hazardous waste operations as defined in 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response;" and
- Activities subject to NEPA environmental assessment or environmental impact statements as defined in 10 CFR 1021.400.

Inside Liquid Storage: A location inside a building that is segregated by either physical barriers or a distance approved by a Fire Protection Engineer and is used to store any liquid chemical except those that are classified as being ***low hazard*** (see def.); a room or building used for the storage of liquids in containers or portable tanks, separated from other types of occupancies.

Laboratory: a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-productive basis.

Low Hazard: Chemicals that have an NFPA flammability rating of "0" or "1"; a health hazard rating of "0" or "1"; a reactivity rating of "0"; and no special hazard rating such as "oxidizer", "water reactive", or "hazardous polymerization" per NFPA 704, Identification System for Fire Hazards of Materials.

MSDS: Material Safety Data Sheet

NFPA: National Fire Protection Association

Safety Can: approved container of not more than five (5) gallon capacity having a spring closing lid and a spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

System: Piping, pumps and/or containers that are attached together so that the collection can perform some specific function.

4.0 Requirements

Sources[1]	Consolidated Requirements
	4.1 General (Applicable to all operations/activities involving chemicals)
DOE O 440.1A , 4 (j) 48 CFR 970.5204,2 (b)(6)[2]	4.1.1 A hazard prevention/abatement process shall be implemented to ensure that all identified hazards are managed through final abatement or control.
DOE 440.1A, 4 (j)(1)	4.1.1.1 Controls shall be incorporated into facility design and procedures.
DOE 440.1A, 4 (j)(2)	4.1.1.2 Abatement actions shall be prioritized based on risks to workers and promptly implemented for existing hazards identified in the workplace. Workers shall be protected immediately from imminent danger conditions.
DOE 440.1A, 4 (j)(4) 29 CFR 1910.132 (a) 29CFR1910.1450, (i)	4.1.1.3 Hazard controls shall be selected using the following hierarchy: (1) Elimination of the hazard through practices such as chemical substitution or process modification; (2)Engineering controls; (3) Work practices and administrative controls; and (4) Personal protective equipment
DOE 440.1A, (4)(e) 29CFR1910.1200 (b)(1) 29 CFR 1910.132 (d)	4.1.1.4 Workers shall be informed of and involved in identifying and controlling workplace hazards, including decisions on selection of PPE.
DOE 440.1A, Attachment 1, (5) & 4 (l)(1) 29CFR1910.1450, (e)	4.1.2 An industrial hygiene program shall be implemented by professionally- and technically-qualified industrial hygienists to reduce the risk of work-related disease or illness in all chemical operations including laboratories. The program shall specify appropriate process modification (including chemical substitution), engineering, administrative, work practice, and/or personal protective control methods to limit exposures to hazardous materials to acceptable levels.
	4.2 Hazardous Operations[3] (see definition)

[1] Hyperlinks to ANSI, CGA, and NFPA requirements provided here are for general information only, as they require user subscription to a prescribed service in order to access these organizations' source requirements.
[2] This requirement of the DOE Acquisition Regulations (DEAR, ES&H Clause) requires development and implementation of controls as part of an overall documented safety management system.

Sources[1]		Consolidated Requirements
29CFR1910.119, (e)(3)(iii) 29CFR1910.120 (c)(1) 40CFR68.67, (c)(3) 40CFR1502.14 40CFR1502.16	4.2.1	An appropriate combination of chemical substitution, engineering and administrative controls (including the appropriate application of detection methodologies), safe work practices, and PPE shall be implemented to prevent/mitigate adverse impacts from hazardous chemicals on workers, the public, or environment.
10CFR830 Subpart B, Part 204, (b)(4) 10CFR850.25, (c) DOE O 420.1A, 4.2.1 DOE-STD-1120-98 DOE-STD-3009-94 DOE-STD-3011-94 DOE-STD-3016-99 29CFR1910.119, (f) 40CFR68.69, (b) DOE O 420.1A, 4.2.1 (3)	4.2.1.1	Written operating procedures shall be developed that include (1) precautions necessary to prevent worker exposure to chemical hazards, e.g., chemical substitution/process change, engineering controls, administrative controls and PPE); (2) control measures to be taken if physical contact or airborne exposure to chemical hazards can occur; (3) fire safety procedures that govern the use and storage of combustible, flammable and other hazardous materials; (4) measures for controlling hazardous chemical inventory; and (5) any required safety systems and their functions.
29CFR1910.119, (j) 40CFR68.73	4.2.1.2	Process safety equipment and engineering controls shall have (1) written procedures on maintaining their integrity; (2) training of personnel involved in process maintenance activities; (3) documented inspection and testing that meets manufacturer's recommendations and good engineering practices; (4) prompt correction of deficiencies that are outside of acceptable operating limits;
29CFR1910.119, (f)(4) 29CFR1910.120, (d) & (g)(1) 40CFR68.69, (d)	4.2.1.3	Safe work practices shall be implemented such as lockout/tagout; permitted confined space entry; removal of non-essential personnel from hazardous material areas; and site and building access control.
29CFR1910.119, (k) 40CFR68.85	4.2.1.4	Hot work operations (e.g., cutting, welding, brazing) conducted on or near hazardous operations shall be in accordance with fire prevention and protection requirements in 29 CFR 1910.252(a) and shall have a permit that authorizes the work to be performed.
	4.3	**Requirements for Laboratory Use of Chemicals**
29CFR1910.1450 (e)(3)	4.3.1	A chemical hygiene plan shall be prepared for laboratory operations that includes safe operating procedures, hazard control

[3] The requirements for hazardous operations are in addition to requirements associated with those activities specified in Section 4.1.

Sources[1]	Consolidated Requirements
	operations that includes safe operating procedures, hazard control measures, operability requirements for protective equipment, provisions for employee training and medical consultations, designation of individuals responsible for implementing the plan, and provisions for employee protection against extremely hazardous substances
29CFR1910.1450 (e)(3)(viii)	4.3.1.1 Extremely hazardous substances (see def.) include "select carcinogens," reproductive toxins, and substances with a degree of acute toxicity. Provisions, where appropriate, shall include: • Establishment of a designated area • Use of containment devices • Procedures for safe removal of contaminated waste • Decontamination procedures
NFPA 45, 2.2.1.1-4	4.3.2 Fire Hazard Classification – Laboratory units shall be classified Class A (High Fire Hazard), Class B (Moderate fire Hazard), Class C (Low fire Hazard), or Class D (Minimal Fire Hazard), according to the quantities of flammable and combustible liquids present in the lab (outside of the storage area) as specified in Table 2.2.1(a) and Table 2.2.1(b) in NFPA 45.
NFPA 45, 2.2.1.5	4.3.2.1 For the purposes of determining laboratory fire hazard classification and the use of tables 2.2.1(a) and (b),, quantities of liquefied flammable gases shall be treated as if they were Class I flammable liquids (see def.); that is, 4L (1.1gal) of liquefied flammable gas is to be considered equivalent to 4L (1.1 gal) of Class I flammable liquid.
NFPA 45, 4.1-4.6	4.3.3 All laboratory units shall be provided with fire protection appropriate to the fire hazard, including: automatic fire extinguishing systems, standpipe and hose systems, portable fire extinguishers, fire alarm systems, fire prevention programs, and emergency plans.
NFPA 45, 5.1	4.3.4 If a laboratory contains explosion hazards, as defined in sections 2.3.1 and 2.3.2 of NFPA 45, protection shall be provided by one or more of the following: • limiting the amounts of flammable or reactive chemicals or chemicals with unknown characteristics used in or exposed by experiments; • special preventive or protective measures for the reactions, equipment, or materials themselves (e.g., high-speed fire detection with deluge sprinklers, explosion-resistant equipment or enclosures); • remote control equipment; • sufficient deflagration venting in outside walls; and,

Sources[1]	Consolidated Requirements
	• conducting experiments in a detached or isolated building, or outdoors.
NFPA 45, 5.2 -5.5	4.3.4.1 Other explosion hazard protection may be considered including: • Explosion-resistant construction; • Explosion venting; • Controlled access to laboratory; and, • Regularly scheduled inspection and maintenance
NFPA 45, 7.2	4.3.5 Handling of laboratory chemicals
NFPA 45, 7.2.1.1	4.3.5.1 Chemicals shall not be brought into a laboratory work area unless design, construction, and fire protection of the facilities are commensurate with the quantities and hazards of the chemicals involved.
NFPA 45, 7.2.2.1	4.3.5.2 Receiving, transporting, unpacking, and dispensing of chemicals and other hazardous materials shall be carried out by trained personnel in such locations and in such a manner as to minimize hazards from flammable, reactive, or toxic materials.
NFPA 45, 7.2.2.5	4.3.5.3 Class I liquids shall not be stored or transferred from one vessel to another in any access corridor, open plan buildings, or ancillary spaces unprotected from the exit access corridor.
NFPA 45, 7.2.2.6	4.3.5.4 Transfer of Class I liquids to smaller containers from bulk stock containers not exceeding 19L (5 gal) in capacity shall be performed as follows: • In a laboratory hood; • In an area provided with ventilation adequate to prevent accumulations of flammable vapor/air mixtures from exceeding 25 percent of the lower flammable limit; • In a liquid storage area specifically designed and protected for dispensing Class I flammable liquids that meet the requirements of NFPA 30, *Flammable and Combustible Liquids Code.*
NFPA 45, 7.2.2.7	4.3.5.5 Transfer of Class I liquids from containers of 19L (5 gal) or more capacity shall be carried out as follows: • In a separate building; OR • In a liquid storage area specifically designed for dispensing Class I flammable liquids that meet the requirements of NFPA 30, Flammable and Combustible Liquids Code.

Sources[1]	Consolidated Requirements
NFPA 45, 7.2.2.8	4.3.5.6 Class I liquids shall not be transferred between conductive containers of greater than 4L (1.1 gal) capacity unless the containers are electrically interconnected by direct bonding or indirect bonding through a common grounding system. When dispensing Class I liquids involves nonconductive containers larger than 4L (1.1gal), which can be difficult to bond or ground, special dispensing procedures commensurate with the electrical characteristics of the liquid shall be developed and implemented.
NFPA 45, 7.2.3.2	4.3.5.7 Individual containers of flammable or combustible liquids shall not exceed the capacities listed in NFPA 45, Table 7.2.3.2.
NFPA 45, 7.3-5	4.3.5.8 The quantity of flammable solids, solid or liquid oxidizers, or peroxides allowed shall be limited to the minimum quantity necessary to perform the work being done. Handling of materials shall conform to the manufacturers' recommendations.
NFPA 45, 8.1.4-6	4.3.6 Laboratory Compressed Gases – In addition to the requirements in Section 4.3, above, compressed gas cylinders in laboratories must also meet the requirements in sections 4.3.6.1-5 below.
NFPA 45, 8.1.4.1	4.3.6.1 Lecture bottle-sized cylinders of the following gases located in laboratory units shall be kept in a continuously mechanically ventilated hood or other continuously mechanically ventilated enclosure: (1) All gases that have an NFPA 45 Health Hazard Ratings of 3 or 4; (2) All gases that have a NFPA 45 Health Hazard Rating of 2 without physiological warning properties; and (3) Pyrophoric gases
NFPA 45, 8.1.4.2	4.3.6.2 Cylinders of gases that are greater than lecture bottle size and have NFPA 45 Health Hazard Ratings of 3 or 4, and cylinders of gases that have a Health Hazard Rating of 2 without physiological warning properties that are located in laboratory units shall meet both the following conditions: (1) Storage in approved continuously mechanically ventilated gas cabinets; and (2) Compliance with the requirements of Chapter 3, Toxic Gases, of NFPA 55, *Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders.*
NFPA 45, 8.1.4.3	4.3.6.3 Cylinders of pyrophoric gases that are greater than lecture bottle size that are located in laboratory units shall be kept in approved continuously mechanically ventilated, sprinklered gas cabinets.
NFPA 45, 8.1.5.2.1-2	4.3.6.4 Regulator systems in laboratory operations shall be equipped with two gauges, either on the regulator or remote from the regulator, installed as to show both the cylinder pressure and the outlet pressure. When the source cylinder is outside of the laboratory, a station regulator and gauge shall be installed at the point of use to show the outlet pressure.
NFPA 45 8.1.6.3-4	4.3.6.5 Only *in use* cylinders shall be allowed in the immediate work area. A compressed gas cylinder shall be considered in use when it is: (1) connected through a regulator to deliver gas; or

Sources[1]	Consolidated Requirements
	(2) connected to a manifold being used to deliver gas; or (3) a single cylinder secured as a reserve cylinder alongside the cylinder described in (1).
NFPA 45, 8.1.6.5	4.3.6.6 The maximum internal volume (water volume) of all cylinders in each of the listed classifications, in use in the laboratory work area, shall comply with the following [based on internal cylinder volume at 21°, 101 kPa (70°F, 1 atm)]: (a) Maximum Quantity of Flammable Gases. (1) For a laboratory work areas of 500 ft² or less, the internal cylinder volume in standard cubic feet equals 6.0. (2) For a laboratory work area greater than 500 ft² or less, the internal cylinder volume is 0.012 ft³ per ft² lab work area. (b) Maximum Quantity of Oxidizing Gases. (1) For a laboratory work area of 500 ft² or less, the internal cylinder volume in standard cubic feet equals 6.0. (2) For a laboratory work area greater than 500 ft ² or less, the internal cylinder volume is 0.012³ ft per ft² lab work area. (c) Maximum Quantity of Liquidified Flammable Gases. (1) For a laboratory work area of 500 ft² or less, the internal cylinder volume in standard cubic feet equals 1.2. (2) For a laboratory work area greater than 500 ft², the internal cylinder volume is 0.0018 ft³ per ft² labor work area. (d) Maximum Quantity of Health Hazard 3 or 4 gases. (1) For a laboratory work area of 500 ft² or less, the internal cylinder volume in standard cubic feet equals 0.3. (2) For a laboratory work area greater than 500 ft ², the internal cylinder volume is 0.0006 ft³ per ft² lab work area.
NFPA 45, 9.1.2-9.2.7.2	4.3.7 Laboratory Operations and Apparatus – NFPA 45 contains additional laboratory safety controls covering: • Operations: heating, distillation, other separation procedures, drying, mixing and grinding, and operations involving reactions at temperatures and pressures above and below ambient conditions • Apparatus: refrigeration and cooling equipment, heating equipment, pressure equipment, and analytical instruments
	4.4 Combustible Liquids
NFPA 30, 5-2	4.4 Operations involving flammable or combustible liquids shall be located and operated so that they do not constitute a significant fire or explosion hazard to life or property
29CFR1910.106 (b)(6); 29CFR1910.106 (e)(6)(1)	4.4.1 Precautions shall be taken to prevent the unintentional ignition of flammable vapors.

Sources[1]		Consolidated Requirements
NFPA 30, 4-8.5 and 5-9.1		
NFPA 30, 5-9.2	4.4.1.1	Smoking shall be permitted only in designated and properly identified areas.
29CFR1910.106 (e)(8); **NFPA 30, 5-9.3**	4.4.2.2	Welding, cutting, and similar spark-producing operations shall not be permitted in areas containing flammable or combustible liquids until a written permit authorizing such work has been issued.
29CFR1910.106 (e)(6)(ii) **NFPA 30, 5-9.4**	4.4.2.3	All equipment (such as tanks, machinery, and piping) where an ignitable mixture could be present shall be bonded or connected to a ground. The bond or ground or both shall be physically applied or shall be inherently present by the nature of the installation. Electrically isolated sections of metallic piping or equipment shall be bonded to the other portions of the system or shall be individually grounded.
29CFR1910.106, (d)(2)(iii)	4.4.3[4]	Individual containers of flammable or combustible liquids shall not exceed the capacities listed in 29CFR1910.106, Table H-12.
NFPA 30, 4-5.5.2	4.4.4	In an office occupancy, containers of Class I liquids that are outside of an inside liquid storage (see def.) area shall not exceed a capacity of one gallon (3.8 liters). **Exception:** Safety cans are permitted up to a two-gallon capacity.
NFPA 30, 4-5.5.3	4.4.5	In an office occupancy, not more than ten gallons (37.8 liters) of Class I and Class II (see def.) liquids combined shall be kept in a single fire area (see def.) outside of a storage cabinet or an inside liquid storage area, unless the liquids are in safety cans (see def.).
NFPA 30, 4-5.5.4	4.4.6	In an office occupancy, not more than 25 gallons (94.6 liters) of Class I and Class II (see def.) liquids combined shall be kept in a single fire area in safety cans outside of a storage cabinet or an inside liquid storage area.
NFPA 30, 4-5.5.5	4.4.7	In an office occupancy, not more than 60 gallons (227 liters) of Class III (see def.) liquids shall be stored outside of an inside liquid storage area or storage cabinet.
NFPA 30, 4-8.4 and 5-12.3.1	4.4.8	Wherever flammable or combustible liquids are used, either fire extinguishers or pre-connected hoses shall be provided in

[4] *Glass or plastic containers up to one gallon in size may be used for Class IA or IB liquids if either (1) the liquid would be rendered unfit for its intended use by contact with metal, (2) the liquid would corrode a metal container so as to create a leakage hazard, (3) the process would require more than the allowed quantities of liquid of a single assay lot to be used at one time, or (4) the process would require the maintenance of an analytical standard liquid of a quality which is not met by the specified standards of liquids available, and the quantity of the analytical standard liquid required for any one control process exceeds one-sixteenth the capacity of the container allowed under Table 1.*

Sources[1]		Consolidated Requirements
		accordance with NFPA 30.
1910.106 (a)(18)(iii)	4.4.9	Whenever a combustible liquid is heated for use to within 30°F (16.7°C) of its flash point, it shall be handled in accordance with the requirements for the next lower class of liquids.
UFC, 7903.2.2.2	4.4.10	Class I-A (see def.) liquids shall not be used for cleaning.
	4.4.11	If Class I-B, I-C, II, or III-A (see def.) liquids are used for cleaning, they must be used in one of the following manners:
UFC, 7903.2.2.2	4.4.11.1	The cleaning shall be conducted in a room or building that has been constructed in accordance with the Uniform Fire Code, Section 7903.2.3.
UFC, 7903.2.2.2	4.4.11.2	The cleaning shall be performed in a machine listed and approved for such use, which complies with the Uniform Fire Code, Section 7903.2.2.3.
UFC, 7903.2.2.2 and 7903.2.2.4	4.4.11.3	If the cleaning is conducted outside of an approved room or building or outside of a listed and approved machine, then the quantity of Class I-B, I-C, II, or III-A liquids shall not exceed that necessary to facilitate maintenance cleaning operations. Quantities in use shall not exceed 5 gallons (18.9 L) of Class I-B or I-C liquids or 25 gallons (94.6 L) of Class II or III-A liquids.
NFPA 30, 5-12.5.1	4.4.12	An approved (see def.) means for prompt notification of fire or emergency to those within the plant and to the fire department shall be provided.
NFPA 30, 5-12.5.2	4.4.13	Those areas, including buildings, where a potential exists for a flammable liquid spill shall be monitored for the presence of those liquids.
NFPA 30, 5-12.7.1	4.4.14	All fire protection equipment, and associated alarms, interlocks, and controls, shall be properly maintained, and periodic inspections and tests shall be done in accordance with both standard practice and the equipment manufacturer's recommendations.
1910.106 (e)(9)(i); **NFPA 30, 5-12.7.2**	4.4.15	Maintenance and operating practices shall control leakage and prevent spillage of flammable liquids.
1910.106 (e)(9)(i)	4.4.16	Spills shall be cleaned up promptly.
1910.106 (e)(9)(iii); **NFPA 30, 5-12.7.3**	4.4.17	Combustible waste material and residues in operating areas shall be kept to a minimum, shall be stored in covered metal containers, and shall be disposed of daily.
1910.106 (e)(9)(iv); **NFPA 30, 5-12.7.4**	4.4.18	Ground areas around facilities where liquids are used shall be kept free of weeds, trash, or other unnecessary combustible materials.

Sources[1]		Consolidated Requirements
		materials.
1910.106 (e)(9)(ii); **NFPA 30, 5-12.7.5**	4.4.19	Aisles established for movement of personnel shall be maintained clear of obstructions.
1910.106 (e)(2)(iv)(d) **NFPA 30, 5-5.2;** **UFC, 7903.1.3.5, ¶ 4**	4.4.20	Flammable liquids or combustible liquids at temperatures at or above their flash points shall be drawn from or transferred into vessels, containers, or portable tanks using one of the following methods: • from original shipping containers with a capacity of five gallons (19 liters) or less; • from safety cans; • through a closed piping system; • from portable tanks or containers by means of a device that has anti-siphoning protection and that draws through an opening in the top of the tank or container; • by gravity through a listed self-closing valve or self-closing faucet. ***NOTE:*** *Class I-A (see def.) liquids shall not be dispensed by gravity from tanks.*
1910.106 (e)(2)(iv)(d)	4.4.21	Transferring flammable or combustible liquids by means of air pressure on the container or tank shall be prohibited.
1910.106 (d)(4)(v)	4.4.22	Dispensing in inside storage rooms shall be by approved pump or self-closing faucet only.
NFPA 30, 5-5.2.1	4.4.23	If hose is used in the transfer operation, it shall be equipped with a self-closing valve without a hold-open latch in addition to the outlet valve. Only listed or approved hose shall be used.
NFPA 30, 5-5.2.2	4.4.24	Means shall be proved to minimize generation of static electricity. Such means shall meet the requirements of NFPA 30.
1910.106 (e)(6)(ii)	4.4.25	Class I (see def.) liquids shall not be dispensed into containers unless the nozzle and container are electrically interconnected.
NFPA 30, 5-5.2.3	4.4.26	If pumps are used to transfer liquids, means shall be provided to stop the transfer in the event of a spill or fire.
1910.106 (e)(2)(iii)	4.4.27	Areas in which flammable or combustible liquids are transferred from one tank or container to another container shall be separated from other operations in the building by adequate distance or by construction having adequate fire resistance. Adequate natural or mechanical ventilation shall be provided.
NFPA 30, 4-4.5.1	4.4.28	Dispensing of flammable liquids or dispensing of combustible liquids at temperatures at or above their flash points shall not be permitted in cutoff rooms or attached buildings that exceed 1000 ft^2 ($93m^2$) in floor area or in liquid warehouses unless the

Sources[1]		Consolidated Requirements
		dispensing area is suitably cut off from the storage areas in accordance with NFPA 30.
NFPA 30, 4-5.2.10	4.4.29	Dispensing of flammable liquids or of Class II combustible liquids shall not be permitted in general purpose warehouses unless the dispensing area is suitably cut off from other ordinary combustible or liquid storage areas in accordance with NFPA 30, and otherwise complies with NFPA 30.
1910.106 (e)(2)(iv)(a)	4.4.30	Flammable liquids shall be kept in covered containers when not actually in use.
1910.106 (e)(2)(iv)(b)	4.4.31	Where flammable or combustible liquids are used or handled, except in closed containers, means shall be provided to dispose promptly and safely of leakage and spills.
1910.106 (e)(2)(iv)(c)	4.4.32	Class I liquids shall be used only where there are no open flames or other sources of ignition within the possible path of vapor travel.
	4.5	**Compressed Gases –**
29CFR1910.101	4.5.1	Compressed gas cylinders shall be used in accordance with the Compressed Gas Association (CGA) regulations.
29CFR1910.253, (b)(1)(ii) **NFPA 55, 4-2;** **CGA P-1, 3.2.5**	4.5.2	Compressed gas cylinders shall be appropriately labeled. Whenever possible, labels shall be located near the shoulder of the cylinder.
	4.5.2.1	The color of the cylinder shall not be the only means used to identify the gas it contains.
29CFR1910.253, (b)(5)(ii)(L); **ANSI Z49.1 10.8.1.5;** **CGA G-1 5.1.3** **CGA P-1, 3.2.2;** **CGA P-1, 3.2.3;** **NFPA 55, 4-3;**	4.5.2.2	Labels or markings placed on compressed gas cylinders by the manufacturer or distributor shall not be defaced or removed.
ANSI Z49.1, 10.8.1.4 **CGA P-1, 3.2.6,**	4.5.2.3	Cylinders not bearing a legible label or other identification shall not be used and shall be returned to the manufacturer or distributor.
NFPA 51 2-1.3	4.5.2.4	Gas name markings shall not be cut into the metal of the cylinder by the user.
	4.5.3	Compressed gas cylinders shall not be subjected to temperature extremes.
29CFR1910.253, (b)(2)(i)	4.5.3.1	Compressed gas cylinders shall not be exposed to temperatures exceeding 125°F.

Sources[1]		Consolidated Requirements
ANSI Z-49.1, 10.8.1.8;		temperatures exceeding 125°F
CGA P-1, 3.3.3;		
NFPA 55, 6-10.1;		
29CFR1926.350, (b)(3);	4.5.3.2	Direct flames or heat shall not be applied to a compressed gas cylinder.
CGA-P-1, 3.3.3; **CGA P-1 4.2.2.1;** **CGA G-1 5.1.6;** **CGA G-1 5.3.3.12**		
NFPA 55, 6-10.2;		
CGA P-1, 3.3.5;	4.5.3.2.1	Cylinders exposed to fire shall not be shipped or used until the manufacturer or supplier requalifies them in accordance with the pressure and vessel code under which they were manufactured.
NFPA 55, 6-8		
29CFR1910.253, (b)(5)(ii)(L);	4.5.3.2.2	Cylinders shall be kept far enough away from operations such as welding to prevent sparks, hot slag, flames, etc., from reaching them. If cylinders cannot be kept a sufficient distance away, then fire-resistant shields shall be used to separate the cylinders from the hot operations.
ANSI Z49.1 10.8.4.13;		
29CFR1926.350, (b)(1))		
CGA P-1, 3.3.4	4.5.3.3	Cylinders shall not be subjected to artificially low temperatures without the permission of the supplier. Outside storage is not affected by this requirement.
29CFR1926.350, (c)(3);	4.5.4	No structurally damaged or defective cylinders shall be used. Damaged or defective cylinders shall be returned to the supplier.
NFPA 55 6-2		
29CFR1910.253, (b)(5)(ii)(M); **29CFR1926, (c)(2)**	4.5.5	No person other than the cylinder supplier shall mix or refill gases in cylinders. Used, non-refillable containers shall be disposed of according to the manufacturer's recommendation.
ANSI Z49.1, 10.89.1.2; **ANSI Z49.1, 10.8.1.3;**		
CGA P-1, 3.6; **CGA P-13.3.10;** **CGA G-1 5.1.7**		
29CFR1926.350, (c)(2)	4.5.5.1	No one shall use a cylinder's contents for purposes other than those intended by the supplier.
29CFR1910.253, (b)(5)(ii)(N); **29CFR1910.253, (b)(5)(iii)(H);**	4.5.6	No one shall tamper with safety devices in cylinders or valves.
ANSI Z49.1, 10.8.3.4;		
CGA P-1, 3.2.4;		
CGA G-1 5.1.6		
29CFR1910.253,	4.5.6.1	No attempt shall be made to maintain or repair cylinder

Sources[1]	Consolidated Requirements
(b)(5)(ii)(R)(1) & (2); **CGA P-1 3.2.1;** **CGA P-1 3.3.6;** **CGA P-1 3.3.7**	safety devices. Suppliers instructions as to the disposition of the cylinder shall be followed if a cylinder with a faulty valve or safety device is found or if the cylinder is otherwise found to be defective.
29CFR1910.253, (b)(5)(ii)(R)(3)	4.5.6.2 Complete removal of the stem from a diaphragm-type cylinder valve shall be avoided. **NOTE:** Stems may be removed before cylinder disposal.
29CFR1910.253, (b)(2)(ii); **29CFR1910.253, (b)(5)(ii)(G);** **29CFR1910.253, (b)(5)(ii)(H);** **29CFR1926.350, (a)(8);** **29CFR1910,253, (b)(2)(iii);** **ANSI Z-49.1, 10.8.4.10;** **CGA G-1 5.3.3.11;** **CGA G-1 4.2.11**	4.5.7 When compressed gas cylinders are not in use or are empty, their valves shall be closed.
NFPA 55 6-3	4.5.7.1 Compressed gas cylinders containing residual product shall be treated as if they are full except when being examined, serviced, or refilled by a gas manufacturer or distributor.
29CFR1926.350, (a)(1); **29CFR1910.253, (b)(2)(iv);** **29CFR1910.253, (b)(5)(ii)(A);** **ANSI Z-49.1, 10.8.3.6;** **CGA P-1, 3.4.1;** **CGA G-1 5.1.9;** **CGA G-1 5.5.1;** **NFPA 55, 6-4;** **NFPA 55 3-1.5**	4.5.8 Where cylinders are designed to accept valve protection caps, caps shall be in place and hand tight at all times except when connected for use.
CGA P-1 3.4.2; **NFPA 55 6-5;** **NFPA 55 3-1.5**	4.5.9 Where valve outlet caps and/or plugs are provided by the manufacturer, the user shall keep the device on the valve outlet at all times except when secured and connected for use.
CGA P-1 3.4.3; **CGA G-1 5.5.1**	4.5.9.1 Valve outlet caps and/or plugs shall be in place and tightened before shipment of the cylinder back to the supplier.
29CFR1926.350, (a)(5); **29CFR1910.253, (b)(5)(ii)(C);** **ANSI Z-49.1, 10.8.3.2;** **29CFR1926.350, (a)(5)**	4.5.10 Pry bars shall not be used under valves or valve protection caps to pry cylinders loose when frozen or otherwise affixed to the ground. 4.5.10.1 Warm, not boiling water shall be used to thaw cylinders loose.

Sources[1]		Consolidated Requirements
29CFR1910.253, (b)(5)(ii)(K); 29CFR1926, (c)(1); **ANSI Z49.1, 10.8.3.3;** **CGA P-1, 3.3.1;** **CGA G-1 5.1.10**	4.5.11	Compressed gas cylinders shall not be used as rollers or supports.
29CFR1926.350, (a)(11)	4.5.12	Compressed fuel gas cylinders shall not be kept in unventilated enclosures such as lockers or cupboards.
29CFR1910.253, (b)(5)(ii)(J); 29CFR1926.350, (b)(2); **ANSI Z-49.1, 10.8.4.14;** **CGA P-1, 3.3.2;** **CGA G-1 5.1.8;**	4.5.13	Compressed gas cylinders shall not be placed where they can inadvertently become part of an electrical circuit.
NFPA 55, 6-9; **CGA P-1, 3.3.2**	4.5.13.1	When used in conjunction with electric welding, compressed gas cylinders shall not be grounded or used for grounding.
29CFR1926.350, (b)(2); **29CFR1910.253, (b)(5)(ii)(J);** **ANSI Z49.1 10.8.4.14**	4.5.13.2	Electrodes shall not be struck against a compressed gas cylinder to strike an arc.
29CFR 1926.350, (a)(7) & (9); **29CFR1926.350, (b)(3);** **ANSI Z49.1 10.8.4.12;**	4.5.14	Compressed gas cylinders shall be secured in an *upright position* when being used unless specifically designed for a horizontal application.
NFPA 55, 6-6.1; **NFPA 45 8.1.5.1** **29CFR1910.253, (3)(1);** **29CFR1926.350, (f)(1);** **ANSI Z49.1 10.6.7;** **ANSI Z49.1 10.3.3;**	4.5.15	Oxygen and fuel and other compressed gas cylinders, equipment, pipelines or apparatus shall not be used interchangeably with any other gas and each shall be used only for the service for which it was approved.
CGA P-1 3.8.7; **CGA P-1 3.8;** **CGA G-1 5.3.3.4** **CGA G-1 5.3.3.6**	4.5.16	All connections shall be gas tight and no leaks shall be present in the system.
CGA P-1 4.2.1.5	4.5.16.1	A flame shall not be used for the detection of leaks in compressed gas systems. Soapy water is one acceptable method.
NFPA 55, 7-2.1	4.5.17	Areas where toxic or pyrophoric gases are used shall be protected by an automatic fire extinguishing system in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, or NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection.
NFPA 55, 7-2.2	4.5.18	A fire alarm activation station or an approved emergency signal

Sources[1]	Consolidated Requirements
	device shall be installed adjacent to exit doors of buildings and outside of rooms or areas where the toxic, pyrophoric, or flammable gases are used. Activation of the system shall sound a local alarm.
29CFR1926.350, (d)(3); **29CFR1910.253, (b)(5)(iii)(I);** **ANSI Z49.1 10.8.4.1;** **CGA P-1 3.8.8;** **CGA G-1 5.3.1;** **NFPA 51 3-1.4;** **NFPA 51 3-2.5;** **NFPA 51 3-4.5;** **NFPA 45 8.1.5.2**	4.5.19 Compressed gases shall never be used from cylinders or high pressure manifolds without reducing the pressure through a suitable regulator unless the equipment used is designed to withstand full cylinder pressure.
29CFR1910.253, (b)(5)(ii)(P)	4.5.19.1 Unless connected to a manifold, oxygen from a cylinder shall not be used without a regulator.
29CFR1910.253, (e)(6)(i); **29CFR1910.253, (a)(3);** **CGA G-1 5.3.3.4;** **ANSI Z49.1 10.7.2;** **ANSI Z49.1 10.7.1;** **NFPA 51 5-6;** **NFPA 45 8.1.5.2**	4.5.20 Approved gas regulators and pressure reducing valves shall be used only for the gas and pressures for which they are labeled.
29CFR1926.350, (h)	4.5.21 Regulators, including their related gauges, shall be in proper working order while in use.
29CFR1910.253, (e)(6)(iv) **ANSI Z49.1 10.7.3;**	4.5.21.1 Union nuts and connections shall be inspected before cylinder use to detect faulty seals which could cause leakage. Faulty nuts and connectors shall be replaced.
29CFR1910.253, (e)(6)(ii); **ANSI Z49.1 10.7.6;** **CGA P-1 3.2.1;** **CGA G-1 5.1.5;**	4.5.21.2 Repair of regulators or their parts shall be performed by a qualified mechanic.
29CFR1910.253, (b)(5)(iii)(D); **29CFR1926.350, (d)(4);** **ANSI Z49.1 10.8.4.11;** **CGA P-1 3.8.6;** **CGA G-1 5.3.3.11**	4.5.22 Before a regulator is removed from a cylinder, the cylinder valve shall be closed and the pressure released from the regulator.
29CFR1926.350, (d)(2); **29CFR1910.253, (b)(5)(iii)(J);** **ANSI Z49.1 10.7.5;** **ANSI Z49.1 10.8.4.4;** **CGA G-1 5.3.3.7**	4.5.23 Cylinder valves shall always be opened slowly to prevent damage to the regulator.
ANSI Z49.1 10.8.4.4; **CGA P-1 3.8.1**	4.5.23.1 Personnel shall stand to the side and not in front of the regulator orifice when the cylinder valve is opened.

Sources[1]		Consolidated Requirements
ANSI Z49.1 10.8.4.7	4.5.24	When a high pressure gas (non-liquefied) cylinder is in use, the valve shall be fully opened to prevent leakage around the valve stem.
29CFR1910.253, (b)(5)(ii)(E); 29CFR1926.350, (d)(5); 29CFR1910.253, (b)(5)(iii)(L); **ANSI Z49.1 10.8.4.6;** **CGA P-1 3.8.1.1; CGA G-1 5.3.3.10**	4.5.25	Cylinders not having a fixed hand wheel shall have keys, handles or non-adjustable wrenches on valve stems while cylinders are in service.
29CFR1926.350, (d)(2)	4.5.25.1	Manifolded or coupled cylinders shall have at least one such wrench always available.
29CFR1910.253(b)(5)(ii)(Q)(1) **ANSI Z49.1 10.8.4.5;** **CGA P-1 3.8.1.1 &12; CGA G-1 5.3.3.2**	4.5.26	Cylinders having hand wheels shall not be opened using wrenches, hammers or other tools. If the valve cannot be opened by hand, then the manufacturer shall be notified and their directions followed.
29CFR1910.253, (b)(5)(ii)(D); 29CFR1926.350, (a)(6); **ANSI Z-49.1, 10.8.3.10;** **CGA G-1 5.2.5**	4.5.27	When cylinders are secured in a suitable hand truck, regulators do not have to be removed and valve protection caps need not be in place before cylinders are moved. When cylinders are to be moved with regulators attached, the cylinder valve must be closed.
29CFR1910.253 (b)(5)(ii)(F); **29CFR1926.350, (a)(8);** **ANSI Z-49.1, 10.8.3.5;** **CGA P-1, 3.8.1**	4.5.28	Cylinder valves shall be closed before moving cylinders.
29CFR1910.253, (b)(5)(ii)(C); 29CFR1926.350, (a)(5); **ANSI Z-49.1, 10.8.3.7**	4.5.29	Valve protection caps shall not be used for lifting cylinders.
29CFR 1910.253, (b)(5)(ii)(A); 29CFR1926.350, (a)(2); **ANSI Z-49.1, 10.8.3.10;** **CGA G-1 5.2.3**	4.5.30	When using a crane, derrick, etc. to transport cylinders, a cradle, boat, pallet, slingboard or other suitable platform shall be used. Compressed gas cylinders shall be secured to the lifting device before they are hoisted.
29CFR1910.252, (b)(5)(ii)(A); 29CFR1926.350, (a)(2); **ANSI Z-49.1, 10.8.3.8;** **CGA P-1 3.5.1-2;** **CGA G-1 5.2.3**	4.5.30.1	Choker slings, ropes, chains or magnets shall not be used to hoist compressed gas cylinders.
29CFR1910. 253, (b)(5)(ii)(B) & (O); **29CFR1910.253, (b)(5)(iii)(B);** **29CFR1926.350, (a)(3);**	4.5.31	Compressed gas cylinders shall not be purposely dropped, struck or permitted to strike each other violently.

Sources[1]	Consolidated Requirements
ANSI Z49.1, 10.8.3.1; **CGA P-1, 3.5;** **CGA G-1 5.2.1, 2 & 6;**	
29CFR1926.350, (a)(4) & (9); **ANSI Z-49.1, 10.8.3.9;** **CGA G-1 5.2.5**	4.5.32 When compressed gas cylinders are transported by motor vehicle, they shall be secured in an upright position.
29CFR1926.350, (a)(3); CGA P-1 3.5	4.5.33 When large cylinders are moved by hand, they shall be tilted and rolled on their bottom edge.
29CFR1926.350, (d)(1); **29CFR1910.253, (b)(5)(iii)(C);** **ANSI Z49.1 10.8.4.3;** **CGA G-1 5.3.3.3**	4.5.34 Before connecting a regulator to an oxygen or fuel cylinder valve, the valve shall be inspected, wiped clean and the valve shall be opened momentarily and then closed immediately. This process is called "cracking".
29CFR1926.350, (d)(1); **29CFR1910.253, (b)(5)(iii)(C);** **ANSI Z49.1 10.8.4.2;** **CGA P-1 3.3.9**	4.5.34.1 The person cracking the valve shall stand to one side and not in front of the gas stream. Compressed gas streams shall not be directed towards any person.
29CFR1926.350, (d)(1); **29CFR1910.253, (b)(5)(iii)(D)** **ANSI Z49.1 10.8.4.3;**	4.5.34.2 Fuel cylinder valves shall not be cracked near ignition sources such as flames, welding work, sparks, etc.
29CFR1926.350, (e)(3)	4.5.34.3 Hose connections shall be kept free of grease and oil.
29CFR1910.253, (e)(5)(i); **ANSI Z 49.1 10.6.1;**	4.5.35 Hoses for oxy-fuel gas service shall comply with the Rubber Manufacturers Association IP-7 Specification for Rubber Welding Hose.
29CFR1926.350, (f)(1); **ANSI Z49.1 10.6.2**	4.5.36 Fuel gas hoses shall be red and oxygen hoses shall be green when they are used for welding and cutting activities.
29CFR1910.253, (e)(5)(ii); **29CFR1926.350, (f)(2);** **ANSI Z49.1 10.6.3**	4.5.37 When parallel lengths of oxygen and fuel gas hoses are taped together such as in a welding operation, not more than 4 inches out of every 12 shall be covered by tape.
29CFR1926.350, (f)(3); **29CFR1910.253, (e)(5)(v);** **ANSI Z49.1 10.6.4;**	4.5.38 All hoses used for welding, cutting and other hot work that will be used to carry hazardous gas (for example, oxygen, fuel gases, oxidizers) shall be inspected at the beginning of each working shift that they are to be used and any defective hoses shall be removed from service. Note: Defects in hoses that shall render the hose no longer useable include leaks, burns, and worn places that render the hose unfit for service.
29CFR1910.253, (e)(5)(iii); **ANSI Z49.1 10.6.5**	4.5.39 Hose connections shall comply with the CGA Pamphlet E-1, Regulator Connection Standards.

Sources[1]	Consolidated Requirements
ANSI Z49.1 10.6.5	4.5.39.1 Hose connections for welding gas lines shall not be compatible with breathing air equipment.
29CFR1910.253, (e)(5)(iv); **ANSI Z49.1 10.6.6**	4.5.39.2 Hose connections shall be able to withstand, without leakage, twice the normal operating pressure and not less than 300 p.s.i.
29CFR1910.253, (e)(5)(iv); **ANSI Z49.1 10.6.6**	4.5.39.3 Oil-free air or an oil-free inert gas shall be used to test hose connections.
29CFR1926.350, (f)(6)	4.5.39.4 Storage areas for hoses shall be well ventilated.
29CFR1910.253; **ANSI Z49.1 10,9.3;** **ANSI Z49.1 10.9.4;** **ANSI Z49.1 10.9.5;** **NFPA 51**	4.5.40 Fuel gas and oxygen manifolds capacity limits, locations and design criteria shall be in accordance with NFPA 51, Standard for the Design and Installation of Oxygen Fuel Gas Systems, and 29CFR1910.253, Oxygen-Fuel Gas Welding and Cutting.
29CFR1910.253, (c)(5)(i); **CGA G-1 5.1.4**	4.5.41 Fuel gas and oxygen manifolds shall be installed under the supervision of someone familiar with the proper practices.
29CFR1910.253, (c)(5)(ii); **ANSI Z49.1 10.9.2;**	4.5.42 All manifolds and their parts shall be used only for those gases for which they are approved.
29CFR1910.253, (c)(1)(i); **ANSI Z49.1 10.9.1;** **NFPA 51 3-2.1;** **NFPA 51 3-1.1**	4.5.42.1 Manifolds shall be approved either separately for each of their components or as an assembled unit.
29CFR1926.350, (e)(1)	4.5.43 Manifolds shall bear the name of the substance contained inside in letters at least 1 inch high either directly painted upon the manifold or on a sign permanently affixed to the manifold.
NFPA 51 3-3.5	4.5.43.1 Low pressure manifolds shall be marked as such to prevent the attachment of high pressure cylinders.
29CFR1926.350, (e)(2)	4.5.44 Fuel gas and oxygen manifolds shall be located in safe, well ventilated, accessible locations and not within enclosed spaces.
29CFR1926.350, (e)(3)	4.5.45 Fuel gas and oxygen manifold hose connections shall be such that hoses cannot be interchanged between fuel gas and oxygen manifolds and supply header connections.
29CFR1926.350, (e)(3)	4.5.45.1 Adapters shall not be used to permit the interchange of hoses.
29CFR1926.350, (e)(4)	4.5.46 When not in use, fuel gas and oxygen manifold and header connections shall be capped.
29CFR1926.350, (3)(5)	4.5.47 Nothing shall be placed on top of a fuel gas and oxygen manifold that will damage the manifold or interfere with the

Sources[1]		Consolidated Requirements
		quick closing of the valves.
NFPA 51 3-4.1	4.5.48	Portable outlet headers shall not be used indoors except for temporary service as approved by the Occupational Safety and Fire Protection Department.
29CFR1910.253, (b)(5)(i); 29CFR1926.350,(h)(i); **ANSI Z-49.1, 10.3.1**	4.5.49	Oxygen cylinders, cylinder valves, couplings, regulators, hoses, and other apparatus, shall be kept free from oil, grease, dirt and other flammable or explosive substances. These materials shall not be handled with oily hands or gloves.
29CFR1926.350, (h)(i); 29CFR1910.253, (b)(5)(I)	4.3.49.1	A jet of oxygen gas shall not be directed at an oily surface, greasy clothes, etc.
29CFR1910.253, (e)(6)(iii); **ANSI Z49.1 10.7.4**	4.5.50	Gauges used for oxygen service shall be marked “Use No Oil”.
ANSI Z49.1 10.3.2	4.5.51	Oxygen shall not be used as a substitute for compressed air. For example, it shall not be used in pneumatic tools, to blow out pipelines, to dust off clothing or any similar application.
ANSI Z49.1 10.7.5; ANSI Z49.1 10.8.4.4	4.5.52	Oxygen regulators shall be drained of oxygen before they are attached to a cylinder or a manifold or before the cylinder valve is opened.
CGA P-1 4.4.2	4.5.53	Oxygen in work areas shall not be allowed to exceed 23 percent by volume.
29CFR1910.253, (b)(3)(ii); 29CFR1910.253, (b)(5)(iii)(A); **ANSI Z49.1 10.8.2.5**	4.5.54	Fuel gas cylinders shall be used valve end up.
NFPA 55 7-1.2	4.5.55	Where ignition of a flammable gas by static electricity is possible, means shall be provided to prevent static discharge.
29CFR1926.350, (d)(2); 29CFR1910.253, (b)(5)(iii)(E); **ANSI Z49.1 10.8.4.9;** **CGA G-1 5.3.3.9**	4.5.56	Nothing shall be placed on fuel cylinders while in use that could damage safety devices or interfere with the quick closing of the valve.
29CFR1926.350, (d)(2); 29CFR1910.253, (b)(5)(iii)(K); **ANSI Z49.1 10.8.4.8;** **CGA G-1 5.3.3.8**	4.5.57	Quick opening valves on fuel gas cylinders shall be opened between ¾ and 1 ½ turns unless otherwise specified by the manufacturer.
ANSI Z49.1 10.8.4.15	4.5.58	Withdrawal rates from gas cylinders shall not exceed manufacturer’s recommendations.
29CFR1926.350, (d)(5); **ANSI Z49.1 10.8.5.1;**	4.5.59	If a leak is found around the valve stem of a fuel gas cylinder, then the packing nuts shall be tightened and the cylinder valve closed.

Sources[1]	Consolidated Requirements
CGA G-1 5.6.2 **29CFR1926.350, (d)(5);** **29CFR1910.253, (b)(5)(iii)(F);** **ANSI Z49.1 10.8.5.2;** **CGA G-1 5.6.3**	4.5.59.1 If these actions do not stop the leak (because the leak is in the valve stem, valve seat, cylinder fuse plug, etc.) then the cylinder shall be moved from the work area to a safe location outdoors and the cylinder shall be properly marked.
29CFR1910.253, (b)(5)(iii)(G); **ANSI Z49.1 10.8.5.2;** **CGA G-1 5.6.3**	4.5.59.2 Precautionary signs warning of a fire hazard shall be posted where leaking fuel cylinders are located.
ANSI Z49.1 10.8.5.2	4.5.59.3 If a leaking fuel cylinder cannot be moved, then the area shall be evacuated and the fire department shall be summoned for assistance.
ANSI Z49.1 10.8.5.3; **CGA P-1 4.2.5.1**	4.5.59.4 Small fires at fuel gas cylinders shall be extinguished if possible without endangering personnel by either shutting off the valve or by the use of water.
ANSI Z49.1 10.8.5.3 **CGA P-1 4.2.5.1**	4.5.59.4.1 Personnel shall evacuate the area and the fire department summoned for assistance if a cylinder fire cannot be easily extinguished.
29CFR1910.253, (d)(5)(ii); **NFPA 51 4-4.2;** **NFPA 51 4-5.2**	4.5.60 When compressed gas lines are being purged of air, oxygen or combustible gas, then sources of ignition shall not be allowed near uncapped openings.
NFPA 51 1-3.1	4.5.61 The use of liquid acetylene is prohibited.
	4.5.62 Additional details for the following compressed gases can be found in the listed citations:
29CFR1910.102	4.5.62.1 Acetylene
29CFR1910.103	4.5.62.2 Hydrogen
29CFR1910.104	4.5.62.3 Oxygen
29CFR1910.105	4.5.62.4 Nitrous Oxide

4.6 Specific Chemicals – In addition to the chemical safety controls in the previous sections, there are control requirements for many specific chemicals as shown in the following. Details can be found in the specific citations.

29CFR1910.1014	4.6.1 2-Acetylaminofluorene
29CFR1910.1045	4.6.2 Acrylonitrile
29CFR1910.1011	4.6.3 4-Aminodiphenyl
29CFR1910.1018	4.6.4 Arsenic, inorganic
29CFR1910.1001	4.6.5 Asbestos
29CFR1910.1028	4.6.6 Benzene

Sources[1]	Consolidated Requirements
29CFR1910.1010	4.6.7 Benzidine
10CFR850	4.6.8 Beryllium
29CFR1910.1051	4.6.9 1,3-Butadiene
29CFR1910.1027	4.6.10 Cadmium
29CFR1910.1008	4.6.11 bis-Chloromethyl ether
29CFR1910.1044	4.6.12 1,2-dibromo-3-chloropropane
29CFR1910.1007	4.6.13 3,3'-Dichlorobenzidine (and its salts)
29CFR1910.1015	4.6.14 4-Dimethylaminoazobenzene
29CFR1910.1012	4.6.15 Ethyleneimine
29CFR1910.1047	4.6.16 Ethylene oxide
29CFR1910.1048	4.6.17 Formaldehyde
29CFR1910.1025	4.6.18 Lead
NFPA 485	4.6.19 Lithium
NFPA 480	4.6.20 Magnesium solids and powders
29CFR1910.1006	4.6.21 Methyl chloromethyl ether
29CFR1910.1052	4.6.22 Methylene chloride
29CFR1910.1050	4.6.23 Methylenedianiline
29CFR1910.1004	4.6.24 alpha-Naphthylamine
29CFR1910.1009	4.6.25 beta-Naphthylamine
29CFR1910.1003	4.6.26 4-Nitrobiphenyl
29CFR1910.1016	4.6.27 N-Nitrosodimethylamine
29CFR1910.1013	4.6.28 beta-Propiolactone
NFPA 481	4.6.29 Titanium
29CFR1910.1017	4.6.30 Vinyl chloride
NFPA 482	4.6.31 Zirconium

Appendix A

Source Documents

ANSI Z49.1, (1994), "Safety in Welding, Cutting, and Allied processes"

CGA P-1, (1991), "Safe Handling of Compressed Gases in Containers"

DOE O 420.1A, "Facility Safety"

DOE O 440.1A, "Worker Protection Management"

NFPA 30, (1996), "Flammable and Combustible Liquids Code."

DOE-STD-1120-98, "Integration of Environment, Safety, and Health into Facility Disposition Activities"

DOE-STD-3009-94, "Preparation Guide for U.S. DOE Nonreactor Nuclear Facility Safety Analysis Reports"

DOE-STD-3011-94, "Guidance for Preparation of DOE 5480.22 (TSR) and DOE 5480.23 (SAR) Implementation Plans"

DOE-STD-3016-99, "Limited Standard; Hazard Analysis Reports for Nuclear Explosive Operations"

NFPA 45, (2000), "Standard on Fire Protection for Laboratories Using Chemicals."

10 CFR 830, "Nuclear Safety Management," Subpart B, "Safety Basis Requirements"

10 CFR 850, "Chronic Beryllium Disease Prevention Program"

10 CFR 1021, "National Environmental Policy Act Implementing Procedures"

29 CFR 1910.101, "Compressed Gases (general requirements)"

29 CFR 1910.119, "Process Safety Management of Highly Hazardous Chemicals"

29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response"

29 CFR 1910.132, "Personal protective Equipment"

29 CFR 1910.1200, "Hazard Communication."

29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories"

40 CFR 68, "Chemical Accident Prevention Provisions"

48 CFR 970, "DOE Management and Operating Contracts"